

WASTE STREAM	5B309	Materials Test Reactor LLW
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SITE Dounreay

SITE OWNER Nuclear Decommissioning Authority

WASTE CUSTODIAN Nuclear Restoration Services Ltd (NRS)

WASTE TYPE LLW

WASTE VOLUMES

	Reported (m ³)	OR	Conditioned (m ³)	Packaged (m ³)
Stocks:	At 1.4.2025	0		
Future arisings:	1.4.2025 - 31.3.2026	= 24.0		
	1.4.2026 - 31.3.2027	= 24.0		
	1.4.2027 - 31.3.2028	= 24.0		
	1.4.2028 - 31.3.2029	= 24.0		
	1.4.2029 - 31.3.2030	= 24.0		
	1.4.2030 - 31.3.2031	= 24.0		
	1.4.2031 - 31.3.2032	= 24.0		
	1.4.2032 - 31.3.2033	= 24.0		
	1.4.2033 - 31.3.2034	= 24.0		
	1.4.2034 - 31.3.2035	= 24.0		
	1.4.2035 - 31.3.2036	= 24.0		
	1.4.2036 - 31.3.2037	= 24.0		
	1.4.2037 - 31.3.2038	= 24.0		
	1.4.2038 - 31.3.2039	= 24.0		
	1.4.2039 - 31.3.2040	= 63.6		
	1.4.2040 - 31.3.2041	= 75.1		
	1.4.2041 - 31.3.2042	= 238.7		
Total future arisings:		713.2		
Total waste volume:		713.2		

Number of waste packages in stock: At 1.4.2025..... - packages

Comment on arising rates: Programme data is based on Life Time Plan 2024 dataset generated in December 2023

Additional information on quantities: -

Uncertainty factors on volumes: Stock (upper): x - Arisings (upper): x 1.02
Stock (lower): x - Arisings (lower): x 0.80

WASTE SOURCE Reactor decommissioning.

PHYSICAL CHARACTERISTICS

General description: Hard decommissioning waste produced from dismantling items of plant and concrete from the Materials Test Reactor bioshield. There may be several large items that may require special consideration either for weight or size reasons.

Changes since waste generated: -

Bulk density (t/m³): = 0.65

Comment on density: Based on actuals data from Dounreay's waste consignment system Data considered acceptable for 2025 submission.

CHEMICAL COMPOSITION

General description and components (%wt): Aluminium (0.06%), Asbestos (0.01%), Cementitious material (e.g. concrete) (27.70%), Copper (5.00%), Lead (1.94%), Mild Steel (63.39%), Other (0.04%), Paper (0.22%), Plastic (0.79%), Rubber (0.25%), Stainless steel (0.32%), Wood/ Wood composite (0.28%),

Chemical state: Neutral

Sheet metal proportion / thickness: 0.830871043610268% by wt of all metals will be sheet from ventilation and ducting. Assumed sheet metal thickness is of a range between 1.6-2.5mm.
1.10782805814702% by wt of all metals will be bulk from tanks and gloveboxes.

Metals and alloys (%wt):

	(%wt)	Type(s) / Grades(s) with proportions	% of total C14 activity
Stainless steel.....	= 0.10	-	
Other ferrous metals.....	= 43.9	-	
Iron.....	0	-	
Aluminium.....	= 0.06	-	
Beryllium.....	0	-	
Cobalt.....	0	-	
Copper.....	= 6.1	-	
Lead.....	= 0.42	-	
Magnox/Magnesium.....	0	-	
Nickel.....	0	-	
Titanium.....	0	-	
Uranium.....	0	-	
Zinc.....	0	-	
Zircaloy/Zirconium.....	0	-	
Other metals.....	0	Not specified.	

Organics (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Total cellulotics.....	= 7.4	-	
Paper, cotton.....	= 3.0	-	
Wood.....	= 4.4	-	
Halogenated plastics.....	= 4.7	-	
Total non-halogenated plastics.....	= 4.7	-	
Condensation polymers.....	NE	-	
Others.....	NE	-	
Organic ion exchange materials.....	0	-	
Total rubber.....	= 1.8	-	
Halogenated rubber.....	NE	-	
Non-halogenated rubber.....	NE	-	
Hydrocarbons.....	0	-	
Oil or grease.....	0	-	
Fuel.....	NE	-	
Asphalt/Tarmac (cont.coal tar).....	0	-	
Asphalt/Tarmac (no coal tar).....	0	-	
Bitumen.....	0	-	
Others.....	NE	-	
Other organics.....	= 0.40	Other 0.40%.	

Other materials (%wt):

	(%wt)	Type(s) and comment	% of total C14 activity
Inorganic ion exchange materials.....	0	-	
Inorganic sludges and flocs.....	0	-	
Soil.....	0	-	
Brick/Stone/Rubble.....	0	-	
Cementitious material.....	= 30.3	-	
Sand.....	0	-	
Glass/Ceramics.....	0	-	
Graphite.....	0	-	
Desiccants/Catalysts.....	0	-	
Asbestos.....	= 0.01	Site asbestos register does not specify friability	
Non/low friable.....	NE	-	
Moderately friable.....	NE	-	
Highly friable.....	NE	-	
Free aqueous liquids.....	0	-	
Free non-aqueous liquids.....	0	-	
Powder/Ash.....	0	-	

COMPONENTS OF MATERIALS, WASTE PROPERTIES, MATERIALS NOT CONTRIBUTING TO MASS

Inorganic anions (%wt):

	(%wt)	Type(s) and comment
Fluoride.....	0	-
Chloride.....	NE	-
Iodide.....	NE	-
Cyanide.....	0	-
Carbonate.....	NE	-
Nitrate.....	NE	-
Nitrite.....	NE	-
Phosphate.....	0	Gypsum
Sulphate.....	0	-
Sulphide.....	NE	-

Materials of interest for waste acceptance criteria:

	(%wt)	Type(s) and comment
Combustible metals.....	NE	-
Low flash point liquids.....	NE	-
Explosive materials.....	NE	-
Phosphorus.....	NE	-
Hydrides.....	NE	-
Biological etc. materials.....		-
Biodegradable materials.....	0	-
Putrescible wastes.....	NE	-
Non-putrescible wastes.....	NE	-
Corrosive materials.....	NE	-
Pyrophoric materials.....	NE	-
Generating toxic gases.....	NE	-
Reacting with water.....	0	-
Higher activity particles.....		-
Soluble solids as bulk chemical compounds.....	NE	-

Hazardous substances / non hazardous pollutants:

-

	(%wt)	Type(s) and comment
Acrylamide.....		-
Benzene.....	0	-
Chlorinated solvents.....	NE	-
Formaldehyde.....	NE	-
Organometallics.....	NE	-
Phenol.....	NE	-
Styrene.....	NE	-
Tri-butyl phosphate.....	NE	-
Other organophosphates.....	NE	-
Vinyl chloride.....		-
Arsenic.....	0	-
Barium.....		-
Boron.....	0	-
Boron (in Boral).....		-
Boron (non-Boral).....		-
Cadmium.....	0	-
Caesium.....		-
Selenium.....	0	-
Chromium.....	0	-
Molybdenum.....	0	-
Thallium.....		-
Tin.....	0	-
Vanadium.....	0	-
Mercury compounds.....	0	-
Others.....		-

Complexing agents (%wt):

Not yet determined

	(%wt)	Type(s) and comment
EDTA.....	NE	-
DPTA.....	NE	-
NTA.....	NE	-
Polycarboxylic acids.....	NE	-
Other organic complexants.....	NE	-
Total complexing agents.....	NE	-

Physical components:

	Number	Type(s) and comment
Sources.....	= 0	-
Electronic & Electrical Equipment (EEE)		
EEE Type 1.....	= 0	-
EEE Type 2.....	= 0	-
EEE Type 3.....	= 0	-
EEE Type 4.....	= 0	-
EEE Type 5.....	= 0	-

TREATMENT, PACKAGING AND DISPOSAL

Planned on-site / off-site treatment(s):

Treatment	On-site / Off-site	Stream volume %
Size reduction	On-site	= 56.0
Decay storage		
Low force compaction		
Supercompaction (HFC)		
Incineration		
Drying/dewatering/liquid separation	On-site	= 100.0
Tie down/fixatives/strippable coating/painting application		
Decontamination		
Metal treatment		
Recycling / reuse		
Thermal treatment, including vitrification		
Encapsulation		
Polymer encapsulation		
Other physical treatment		
Other chemical treatment		
Containerisation		
Treatment not yet determined		
None		

Comments on planned treatments:

Uncompacted drums will be supercompacted before being placed in HHISOs. The waste will be encapsulated before final disposal

Conditioning method:

For LLW, waste will be grouted into non IP rated HHISOs through a dedicated grouting facility

Conditioning plants:

Plant Name	Location

Likely conditioning matrix:

Non-standard

Further information on the conditioning matrix:

Dounreay uses: OPC 1:3 PFA ~35% Water content and plasticiser.

Waste Packaging:

Likely container type:

Container	Waste packaged (vol%)	Waste loading (m³)	Payload (m³)	Number of packages	Estimated start date for packaging
Non IP-2 rated 1/2 Height ISO (DC02)	100.0	14.3	15.6	50	-

Range in container waste loading:

The waste loading value is a rough average using previously consigned waste data. Waste loading per ISO can vary significantly, based on how the container is loaded. In general, bulk items lead to a lower waste loading value whereas compactable items lead to a higher one. Most containers contain a mix of the two

Other information on packaging and conditioning:

The waste, when consigned, will mainly consist of large uncompactable items and a few compacted 200 litre drums. The waste will be loaded into alternative non-IP2 rated LLW disposal HHISO for transfer to the NRS Dounreay LLW Disposal Facility. Each HHISO may have other LLW items in the final HHISO

Conditioned density (t/m³):

= 2.0

Conditioned density comment:

This value is the midpoint between a range of densities going from 1.49-2.47. These were taken from HHISOs disposed of in NRSD LLW Disposal Vaults

Management Routes:

Disposal Route	Stream volume %	Raw density t/m³	Start date
Expected to be consigned to a Near Site, Near Surface Disposal Facility (Scotland)	= 100.0		
Expected to be Non-NSD HAW managed under Scottish Government's policy			
Expected to be disposed to LLW Vaults NRS Dounreay			
Expected to be consigned to the Geological Disposal Facility			
Expected to be consigned to a Near Surface Disposal Facility			
Expected to be consigned to the LLW Repository			
Expected to be consigned to a Landfill Facility			
Expected to be disposed On-Site			
Expected to be managed by In-Situ Disposal			
Expected to be consigned to an Incineration Facility			
Expected to be consigned to a Metal Treatment Facility			
Expected to be Out of Scope			
Expected to be recycled / reused			
Disposal route not known			

Classification codes for waste expected to be consigned to a landfill facility:

Opportunities for alternative disposal routing: Yes

Baseline Management Route	Opportunity Management Route	Stream volume (%)	Opportunity Confidence	Comment
Dounreay LLWDV	Incineration facility	< 56.0	GREEN	This opportunity is still at an early stage of development. A small scale trial has taken place. This can potentially divert up to all compactable LLW. The incinerables waste route % is a theoretical maximum based on 100% of drummed LLW being suitable for incineration. This % is subject to further review by NRS Dounreay.
Dounreay LLWDV	Metal treatment facility	~ 13.0	GREEN	Trials have progressed to open the Metal Treatment Route. It is expected that the waste route will open in 2025. The metallic waste treatment route % remains indicative and is subject to further review and characterisation by NRS Dounreay.

RADIOACTIVITY

Source: Activation products in reactor structure and contamination of reactor components.

Uncertainty: -

Measurement of radioactivities: Derived activity from consignment information

Chemical form of radionuclides:

- H-3: Likely to be present.
- C-14: Likely to be present.
- Cl-36: Likely to be present.
- Se-79: -
- Tc-99: -
- I-129: Not expected to be present.
- Ra: Not expected to be present.
- Th: Not expected to be present.
- U: Not expected to be present.
- Np: Not expected to be present.
- Pu: Not expected to be present.

WASTE STREAM 5B309 Materials Test Reactor LLW									
Nuclide	Mean radioactivity, TBq/m³				Nuclide	Mean radioactivity, TBq/m³			
	Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code		Waste at 1.4.2025	Bands and Code	Future Arisings	Bands and Code
H 3			= 2.91E-12	C C 2	Gd 153				
Be 10					Ho 163				
C 14			= 8.16E-13	C C 2	Ho 166m				
Na 22					Tm 170				
Al 26					Tm 171				
Cl 36					Lu 174				
Ar 39					Lu 176				
Ar 42					Hf 178n				
K 40					Hf 182				
Ca 41					Pt 193				
Mn 53					Tl 204				
Mn 54					Pb 205				
Fe 55					Pb 210				
Co 60			= 1.17E-14	C C 2	Bi 208				
Ni 59					Bi 210m				
Ni 63			= 6.70E-13	C C 2	Po 210				
Zn 65					Ra 223				
Se 79					Ra 225				
Kr 81					Ra 226				
Kr 85					Ra 228				
Rb 87					Ac 227				
Sr 90					Th 227				
Zr 93					Th 228				
Nb 91					Th 229				
Nb 92					Th 230				
Nb 93m					Th 232				
Nb 94					Th 234				
Mo 93					Pa 231				
Tc 97					Pa 233				
Tc 99					U 232				
Ru 106					U 233				
Pd 107					U 234				
Ag 108m			= 2.14E-14	C C 2	U 235				
Ag 110m					U 236				
Cd 109					U 238				
Cd 113m					Np 237				
Sn 119m					Pu 236				
Sn 121m					Pu 238				
Sn 123					Pu 239				
Sn 126					Pu 240				
Sb 125					Pu 241				
Sb 126					Pu 242				
Te 125m					Am 241				
Te 127m					Am 242m				
I 129					Am 243				
Cs 134					Cm 242				
Cs 135					Cm 243				
Cs 137			= 7.61E-14	C C 2	Cm 244				
Ba 133			= 8.08E-14	C C 2	Cm 245				
La 137					Cm 246				
La 138					Cm 248				
Ce 144					Cf 249				
Pm 145					Cf 250				
Pm 147					Cf 251				
Sm 147					Cf 252				
Sm 151					Unsp a				
Eu 152					Unsp b/g				
Eu 154					Total a	0	*	0	*
Eu 155					Total b/g	0	*	4.59E-12	*

Bands (Upper and Lower)

A a factor of 1.5
B a factor of 3
C a factor of 10
D a factor of 100
E a factor of 1000

Note: Bands quantify uncertainty in the mean radioactivity.

Code

1 Measured activity
2 Derived activity (best estimate)
3 Derived activity (upper limit)
4 Not present
5 Present but not significant
6 Likely to be present but not assessed
7 Present in significant quantities but not determined
8 Not expected to be present in significant quantity
* Total calculated from the 114 declared radionuclides